

THE IMPORTANCE OF AGROFORESTRY FOR POLLINATOR ABUNDANCE AND DIVERSITY



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Introduction

Agroforestry is a well-known agricultural practice, but it remains uncommon in modern intensive farming systems, especially in Denmark. Hedgerows in agricultural landscapes are key habitat elements for many organisms, including pollinating insects. This study aims to investigate how an agroforestry-like configuration with hedgerows influences abundance and diversity of pollinating insects, how the presence and structure of hedgerows influence crop pollination and how pollinator richness and abundance affect crop yield.

HIGHLIGHTS

- Hedgerow as proxy for alley cropping agroforestry increased total pollinator abundance by 40-42% compared to monoculture mid-fields
- Hoverfly diversity was significantly higher near hedgerows compared to mid-field monoculture
- Wild solitary bee abundance had no significant differences between monoculture and agroforestry; however, a tendency for more solitary bees near hedgerows was found.

The study hypothesised that agroforestry would support higher pollinator diversity and abundance compared to monoculture

To test this, hedgerow-field systems in southern Denmark were used, with hedgerow plots representing an agroforestry proxy and mid-field plots representing monoculture. Flying insects were sampled using pan traps placed both near hedgerows and in mid-field. Captured insects were identified, assigned to pollinator groups, and used to calculate pollinator abundance and diversity at each distance. For analysing crop yield, phytometer plants, of strawberry, fava bean, and pumpkin were grown in a greenhouse, and just before flowering, they were transplanted into the same plots as the pan traps. Just before the host fields were harvested, the yield produced by the phytometer plants was harvested and measured.

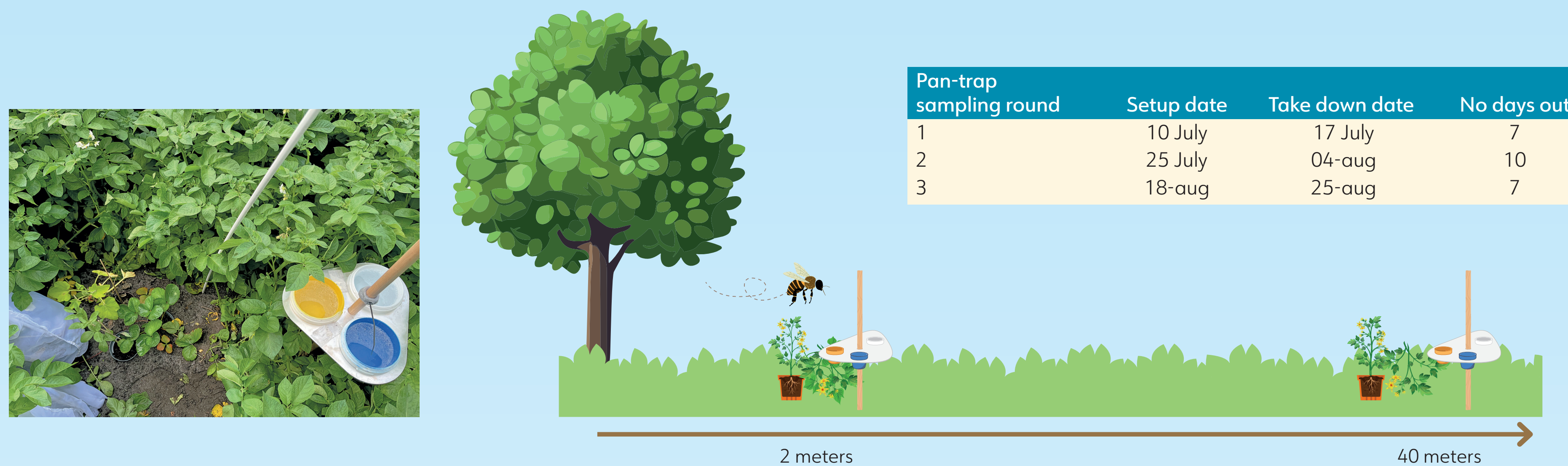


Figure 1. Experimental setup was; three colors of pan-traps set up in each plot, together with phytometer plants, these plots were put out in 2 and 40 meters from hedgerows all in four fields, the phytometer plants were out during their entire flowering period, and the pan-traps were sampled three times during the experimental setup.

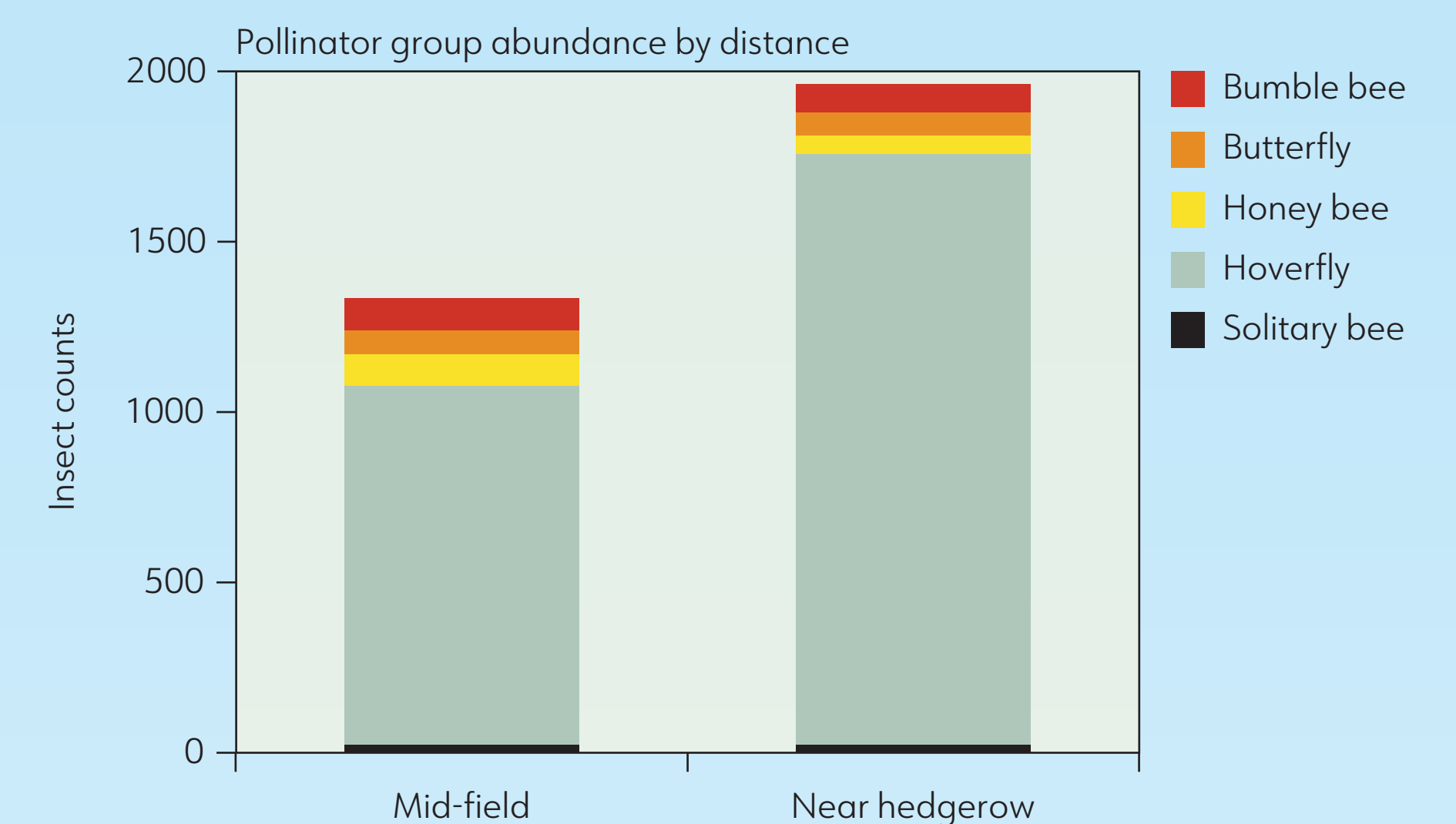
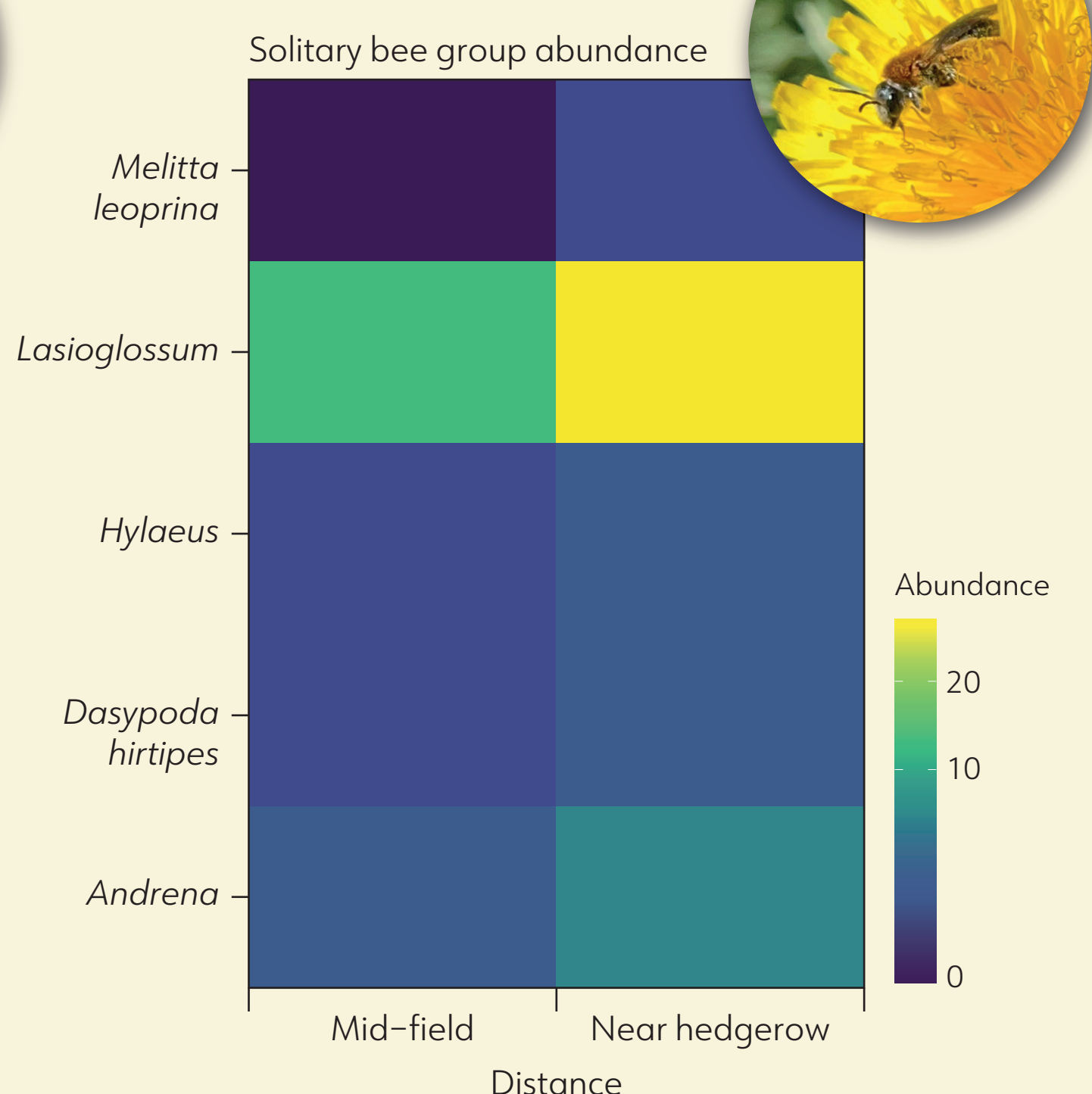
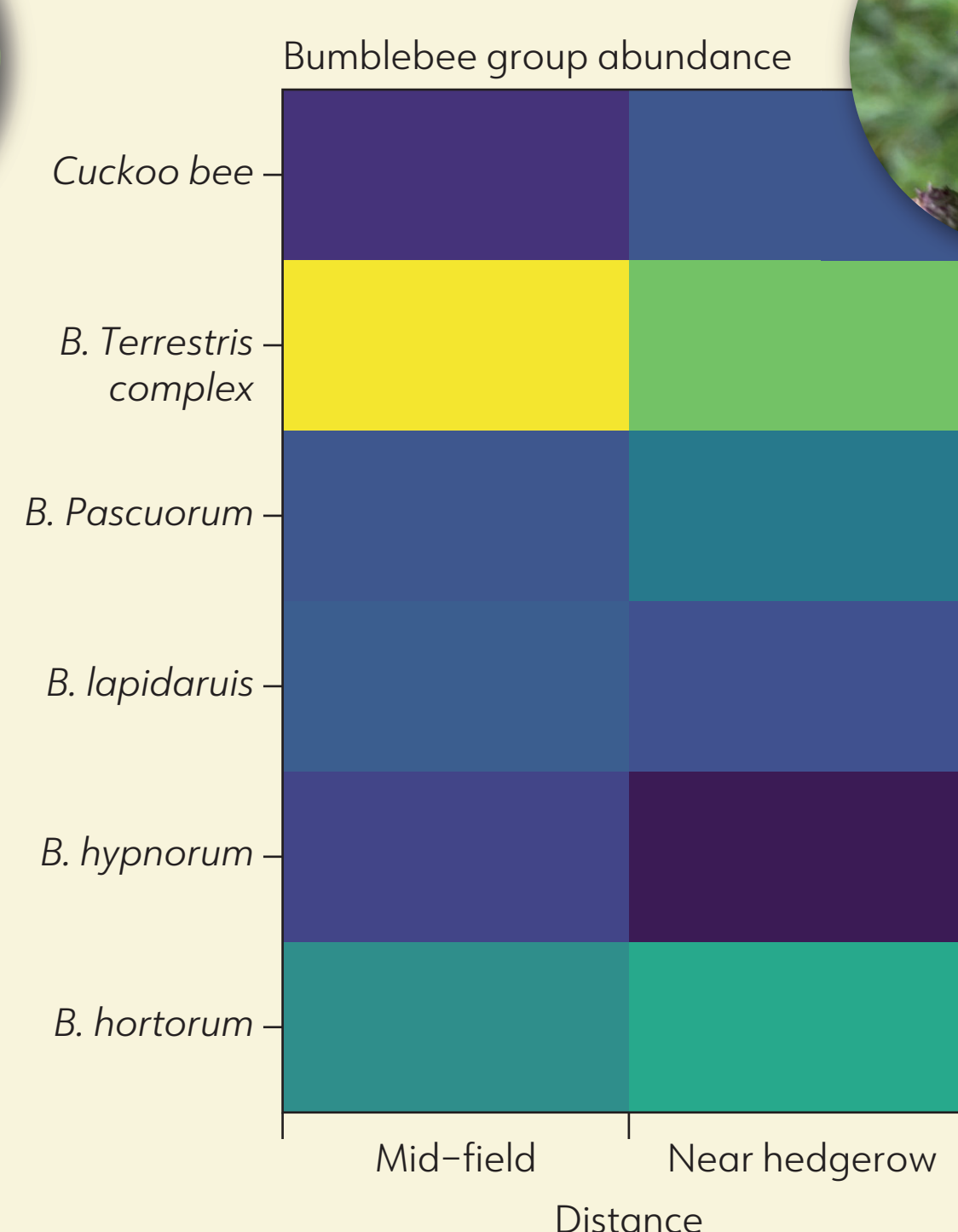
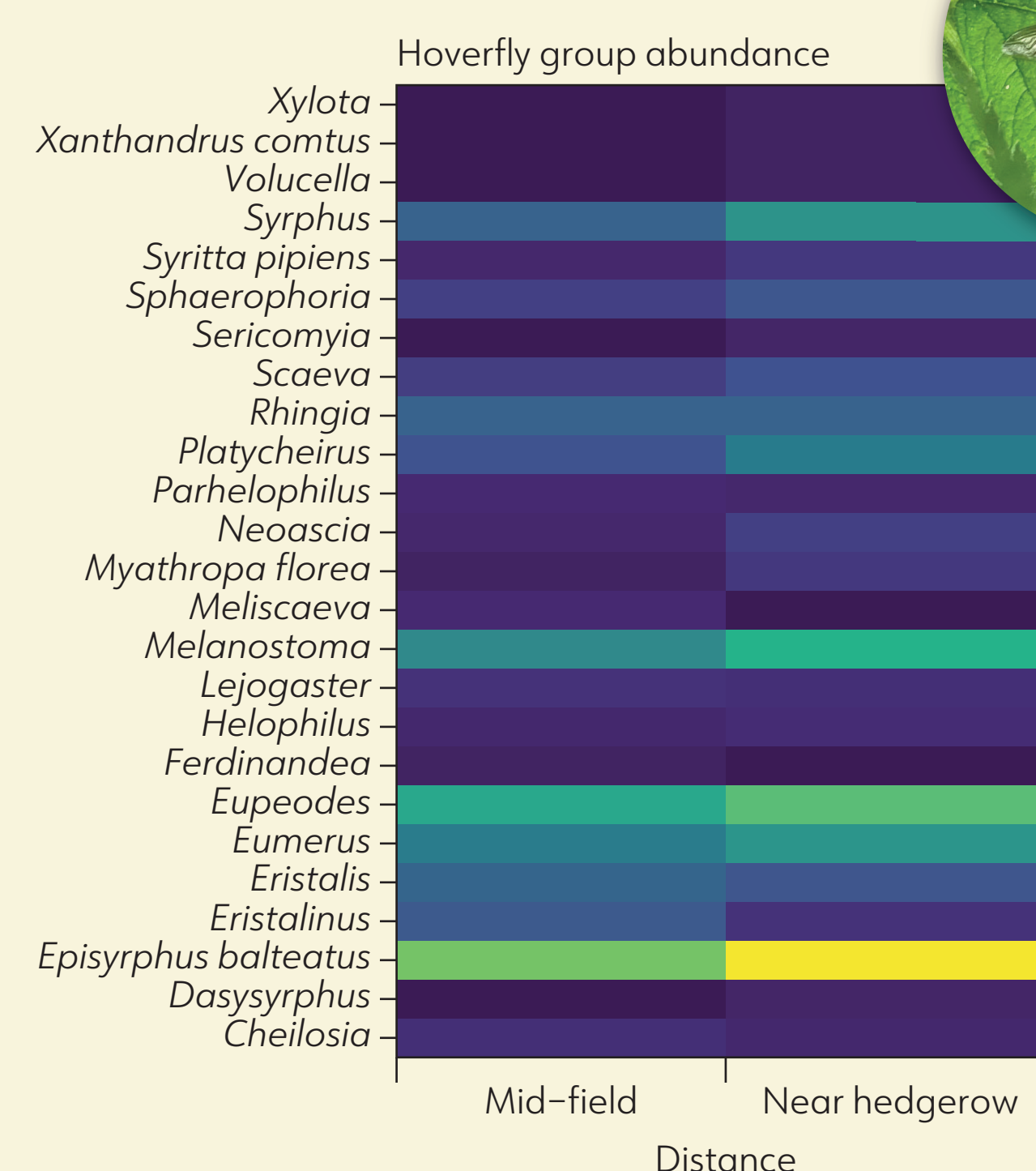


Figure 2. Pollinator group abundance by distance from hedgerow, pollinators were grouped into five categories, bumblebees, butterflies, honeybees, hoverflies, and solitary bees

RESULTS & CONCLUSION

The study showed that insect pollinators had a 40–42% ($p \approx 0.001$) higher total abundance in the agroforestry proxy compared to monoculture (Fig. 2 & 3). Hoverfly genus level diversity was also significantly higher near hedgerows, whereas bumblebees and honeybees showed no significant differences in abundance or diversity between distances (Fig. 3). For pumpkin and faba bean phytometers, harvested fruit and pod numbers were significantly higher in monoculture than in the agroforestry proxy.



Figures 3. Heatmap of hoverfly genus, bumblebee groups, and solitary bee groups recorded at two distances from hedgerows. Colours indicate the relative abundance of each group across all fields and sampling rounds, ranging from dark blue (lowest abundance) to green and yellow (highest abundance).

Hedgerows in this study also showed that higher herbal diversity increased the abundance and diversity of pollinators (Fig. 4 & 5). The hedgerow with the highest pollinator diversity and abundance were also the hedgerow with the highest herbal diversity and not highest diversity of woody species, or the hedgerow with the closest hedge (Fig. 4 & 5).

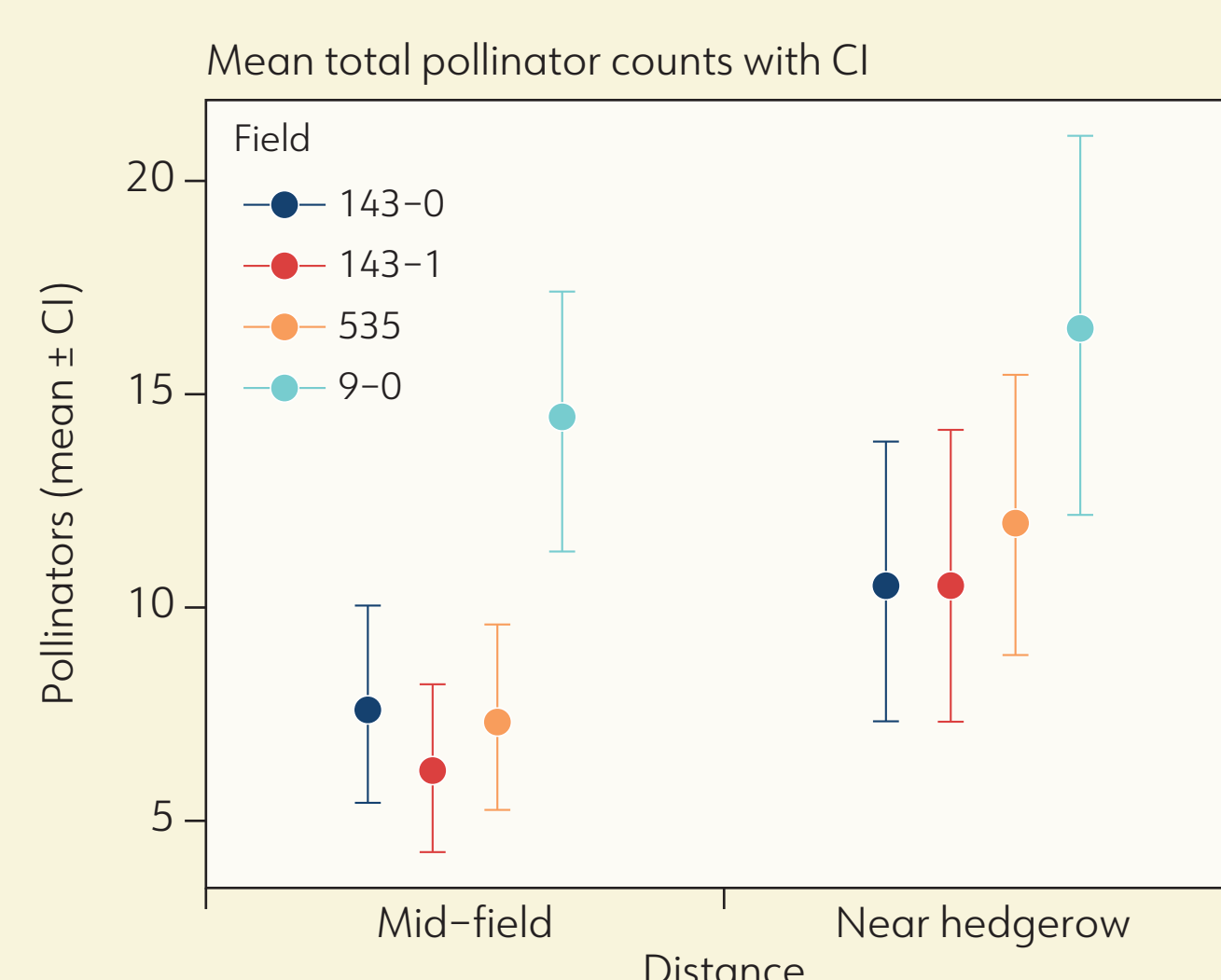


Figure 4. Mean pollinator count (with confidence interval) at the two examined distances from the hedgerow, the colored dots represent each studied field.

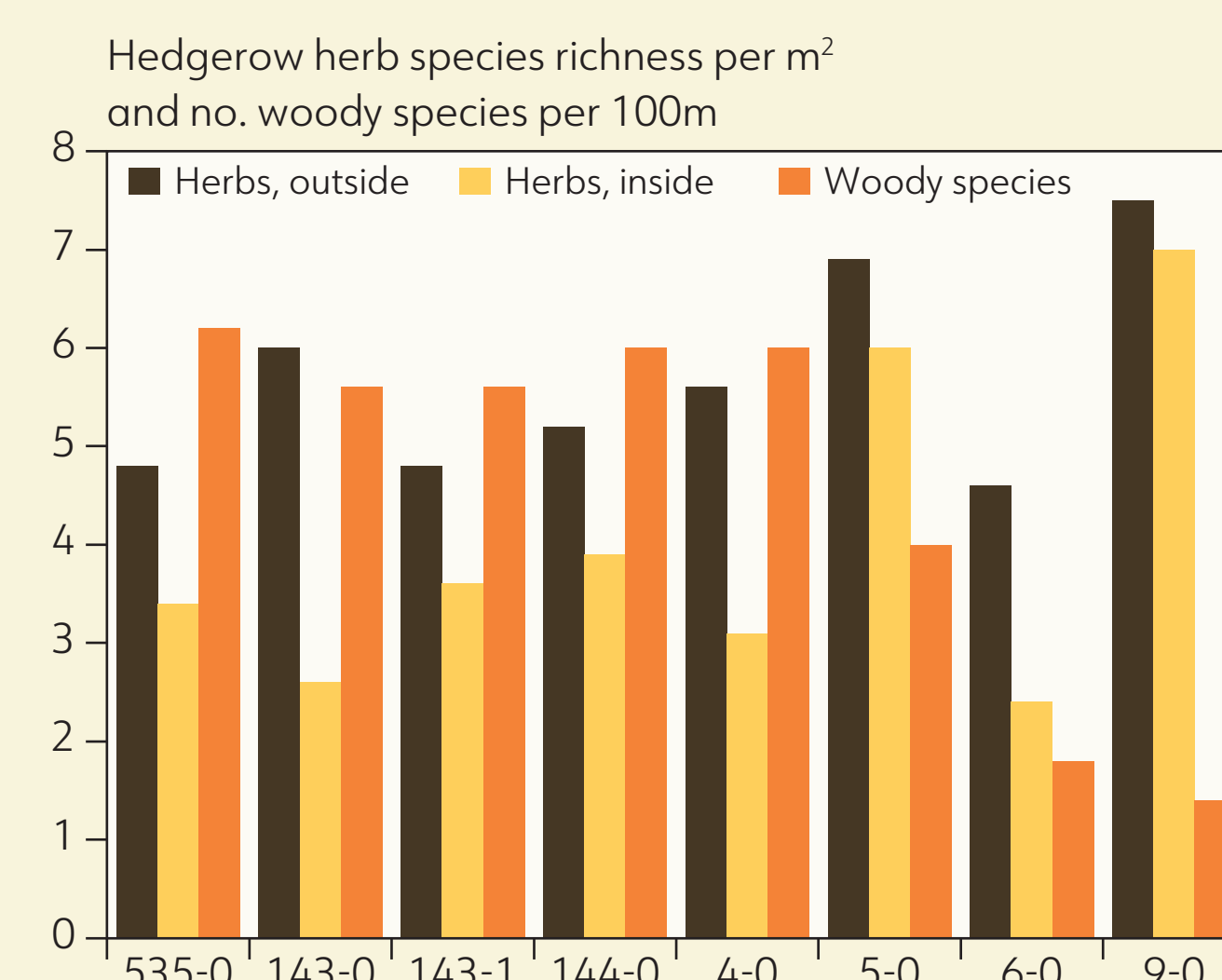


Figure 5. Herb and woody species richness in the hedgerows.

Overall, the study shows that hedgerows increase both the abundance and diversity of many pollinators, particularly hoverflies, in adjacent cropland. However, pollination services did not appear to be strongly limited by distance to hedgerows, likely because key pollinators in the Apidae are willing to forage across the whole field.